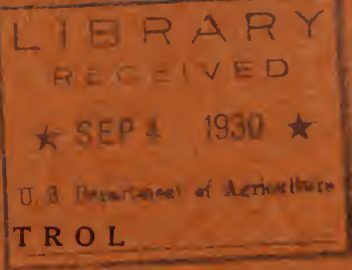


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BLISTER-RUST CONTROL

MASSACHUSETTS

MANUAL FOR FIELD MEN

U.S. Dept of agric - Plant ind., Bur of

MASSACHUSETTS AND UNITED STATES
DEPARTMENTS OF AGRICULTURE
COOPERATING

F A C T S

T H A T

M A S S A C H U S E T T S

B L I S T E R - R U S T F I E L D M E N

S H O U L D K N O W

Compiled by C. C. Perry, Agent
State Blister-Rust Leader

2nd revision - January 1, 1930

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After reading the material as presented herewith, if you find anything that is not entirely clear to you, get in touch with the blister-rust control agent to whom you are responsible, and go over the matter with him personally.

FACTS ABOUT THE DISEASE-BLISTER RUST

WHAT BLISTER RUST IS: Blister rust is a plant disease which is caused by the growth of a parasitic fungus within the inner bark of the white pine tree and in the leaf tissues of Ribes (currant and gooseberry bushes), pronounced Rye-bees.

NAME OF THE FUNGUS: CRONARTIUM RIBICOLA (someone may ask you this) pronounced Crow-nar-shum rye-bick-o-la.

DESCRIPTION OF THE HOST PLANTS: WHITE PINE: The blister rust fungus attacks only those pines which have their leaves - "needles" - in clusters of five. The eastern white pine - Pinus strobus (pronounced Pie-nus stro-buss) is the only five-needled pine native to the eastern United States. In the west, there are seven other native five-needled pines of which the two most important are Pinus monticola - western white pine, and Pinus lambertiana - sugar pine.

RIBES: All species of Ribes are susceptible to the blister rust, altho the European black

currant is the most susceptible species and is responsible for the long-distance spread and establishment of the disease.

For your information there follows a list of the principal species of Ribes which are found in Massachusetts.

Cultivated Ribes:

European Black Currant - Ribes nigrum (R. neye-grum) Leaves quite pointed, broader than long, have resin dots only on the under side. New stems smooth and round. Stems and leaves give off strong odor when crushed. Fruit black, smooth, pungent to taste. Rarely escapes from cultivation.

Red or white currant - Ribes vulgare (R. vul-gare-y) Leaves rather thick, dark green, shaped something like a maple leaf. Fruit red or white, smooth, shiny, tart to taste. Escapes from cultivation quite commonly in Massachusetts.

Flowering currant - Ribes odoratum (R. o-door-ah-tum) Leaf entirely different from leaves of other Ribes, usually distinctly three-lobed, square-shaped at base, thick and rather leathery. Flowers yellow and fragrant. Fruit black. An ornamental shrub used on lawns and as hedge plants.

Commonly called clove or spice bush, and it is often difficult to convince people that it is a true currant. Varies markedly in susceptibility to blister rust but has been found heavily infected in many instances in Massachusetts.

Gooseberry - *Ribes grossularia* (R. grawss-you-lay-rea) Stems may be either smooth or prickly. Fruit greenish yellow or purplish red.

Wild Ribes:

Black currant - *Ribes americanum* (R. a-merry-cane-um) Leaves very thin, slightly heart-shaped, doubly toothed on the margin with small golden or amber spots (resin dots) on both sides. Bushes are often very tall; stems ridged. Fruit smooth, black. Sometimes cultivated.

Red currant - *Ribes vulgare* (R. vul-gare-y) Leaves thick, dark green. This is the same species as the cultivated red currant.

Swamp red currant - *Ribes triste* (R. tris-tee) Straggling

or reclining, the branches often rooting freely. Leaves large and thick, hairy beneath, beautiful dark green, three-lobed, resembling that of the red maple. Fruit smooth, red, small. Uncommon in Massachusetts but found occasionally in Berkshire and Franklin counties.

Skunk currant - *Ribes glandulosum* (R. gland-you-low-some)
Trailing species mostly common in swampy woods.

Propagates itself by trailing along the ground and taking root, developing upright shoots. Leaves thick, leathery hairy below, broader than long. Fruit bristly, red, disagreeable to taste. The species gets its common name from the odor given off by the stems when broken.

Prickly gooseberry - *Ribes cynosbati* (R. si-noss-bat-ee)
Bushes often very tall and large. Stems supplied with stout thorns and bristles. Leaves rather thin, soft and downy. Fruit with coarse, almost spiny bristles. Common in stone walls, pastures, and rocky ledges.

Smooth gooseberry - *Ribes hirtellum* (R. her-tell-um)

Usually small sized bushes. Leaves smooth, rather thick wedge-shaped at base. Fruit smooth, purplish. New stems supplied with soft spines. Fairly common in pastures and in swampy areas.

Prickly-stemmed currant - *Ribes lacustre* (R. lah-cuss-tree)

Leaves thin, resembling those of *R. cynosbati*, but more deeply lobed, 5 to 7 lobed, smooth. Young stems covered with reddish prickles and slim thorns. Old stems slightly armed. Fruit dark purple, small, bristly, unpleasant to taste. Uncommon in Massachusetts but found occasionally in Berkshire and Franklin counties.



ORIGIN OF THE DISEASE: The disease probably originated in Asia and spread over Europe. First reported in Europe in 1857. The introduction of the rust into the U. S. resulted largely from the importation of white pine planting stock principally from German and French nurseries, where the stock had been exposed to infection. It was first discovered in North America at Geneva, New York in 1906 on Ribes, and in 1909 on white pine. There is ample evidence, however, to indicate that it was present in this country as early as 1897, at Kittery Point, Maine.

PRESENT DISTRIBUTION IN THE UNITED STATES: The blister rust is now generally distributed thruout New England, and northeastern New York. It is also present in Pennsylvania, New Jersey, Michigan, Wisconsin, and Minnesota. In the west, it has been found in British Columbia and in the States of Washington, Oregon and Idaho and Montana.

HOW THE DISEASE SPREADS: Blister rust is transmitted by means of minute seed-like structures called spores, which are blown about by the wind or carried by currents of air.

Types of Spores: There are five distinct types of these spores, all but one of which function in the spread of the disease.

The first type (aeciospores) are produced on diseased pines early in the spring April 15 - June 15. These spores transmit the disease to currant and gooseberry leaves upon the under side of which a second type of spore is produced.

Spores of this second type (urediniospores) are liberated about May 15 and at least seven generations of these are produced during the season, thus intensifying the spread of the disease.

In mid-summer a third type (teliospores) appear on the diseased Ribes leaves. These spores germinate and produce a fourth type known as sporidia and these transmit the disease to white pine trees.

A fifth type (pycnospores) appear on the diseased pine bark from June 7 to the winter. These spores are contained in small drops of a very clear, sweet-tasting liquid. As far as is known, however, this stage merely indicates the presence of the disease and these spores in no way act to transmit it.

DISTANCE OF SPREAD: Aeciospores unquestionably travel many miles and recent evidence obtained in the west, indicates a spread of at least 110 miles in one instance.

Urediniospores have been trapped up to a distance of 3200 feet.

Teliospores are not disseminated, but remain in the telial column.

Sporidia are effective under ordinary conditions to distances of 900 feet.

CHARACTERISTIC APPEARANCE OF THE DISEASE ON THE HOST PLANTS:

ON WHITE PINE: Infection takes place thru the breathing pores of the needles during the season of sporidia production. There

follows then a period of incubation of from $1\frac{1}{2}$ to $3\frac{1}{2}$ years before the blisters (aecia) burst thru the bark of the diseased tree. During this incubation or dormant period, the symptoms of the disease are as follows:

(1st season) Small orange yellow spot usually produced from 6 to 8 weeks after the sporidium falls on the needle. This stage is not readily identified in the field.

(2nd season) Filaments of the fungus grow down the needle into the bark of the branch and spread out to a distance of from $\frac{1}{4}$ to 2 inches. The bark becomes pale yellow or slightly orange.

(3rd season) Canker enlarges, pycnial drops may begin to form by June 7 and continue up to the winter. When these drops dry up there remain scars - pycnial scars - which are very characteristic and make identification of the disease certain.

(4th season) In late spring or early summer, blisters appear usually in the zone of the pycnial drops of the previous season.

ON RIBES: The first evidence of the disease on the leaves of Ribes is the development of small patches of a yellowish appearance on the under side of the leaves. As the intensity of the infection increases, these spotted areas increase until they may completely cover the surface of the leaf. In mid-summer, brown hair-like or horn-like projections develop from these patches. These are called telial columns and are composed of the teliospores from which sporidia develop. These columns often become so abundant that they may completely cover the under surface of the leaf, giving to it a decidedly rusty appearance.

HOW BLISTER RUST CAN BE CONTROLLED: The critical point in the so-called life history of the fungus is that it cannot propagate itself on one host plant, but requires two distinct hosts. It is apparent, therefore, that if the two sets of hosts plants are separated widely enough so that the spores produced upon

one cannot reach the other, the disease cannot spread. Control, therefore, simply involves the elimination of the less valuable host, which in most localities in Massachusetts is certainly the currant or gooseberry bush.

AVAILABLE PUBLICATIONS REGARDING BLISTER RUST:

By application to the Blister Rust Control Agent:

U.S.D.A. Misc. Publication No. 22 (Eastern Edition)
PROTECT WHITE PINE FROM THE BLISTER RUST

U.S.D.A. Misc. Publication No. 27
BLACK CURRANT SPREADS WHITE PINE BLISTER RUST

U.S.D.A. Technical Bulletin No. 87
WHITE PINE BLISTER RUST - A COMPARISON
OF EUROPEAN WITH NORTH AMERICAN CONDITIONS

U.S.D.A. Simplified leaflet
PROTECT WHITE PINE FROM THE BLISTER RUST

By application to the Office of Blister Rust Control

U.S. Bureau of Plant Industry, Washington, D.C.

U.S.D.A. Dept. Bul. 1186

WHITE PINE BLISTER RUST IN WESTERN EUROPE

U. S. D. A. Dept. Circ. 177

TREATMENT OF ORNAMENTAL WHITE PINES INFECTED WITH BLISTER RUST.

U. S. D. A. Farmers Bulletin No. 1398.

CURRANTS AND GOOSEBERRIES - THEIR RELATION TO WHITE PINE BLISTER RUST.

JOURNAL AGRICULTURAL RESEARCH SEPARATE

THE RESULTS OF INOCULATING PINUS STROBUS WITH THE SPORIDIA OF
CRONARTIUM RIBICOLA.

MIMEOGRAPHED ARTICLE

STUDIES OF RIBES ECOLOGY.

AVAILABLE PUBLICATIONS CONCERNING SUBSTITUTES FOR CULTIVATED RIBES



By application to Office of Blister Rust Control, B.P.I.
Washington, D. C.

Mimeographed articles - "Edible Fruits Borne on Many Ornamental
Shrubs."

"Substitutes for Currants and Gooseberries."

AVAILABLE INFORMATION REGARDING AGRICULTURAL SUBJECTS:

For general information on agricultural subjects, refer the
questioner to the Office of the Extension Service, located in
the district, or to the Massachusetts Department of Agriculture.
Room 136 State House, Boston, Mass. The blister rust control
agent has a supply of cards - SERVICE REQUEST CARD-AGRICULTURE-
which may be used for this purpose.

AVAILABLE INFORMATION REGARDING FORESTRY:

Matters pertaining to Forestry in Massachusetts, are handled
by the State Department of Conservation. Persons requesting



specific information on forest planting and other forestry problems should be referred to the Division of Forestry, Department of Conservation, State House, Boston, Mass. A card form - SERVICE REQUEST CARD-FORESTRY-- may be used for this purpose. These cards can be obtained from the blister rust control agent.

F A C T S A B O U T T H E O C C U R R E N C E O F
B L I S T E R R U S T I N M A S S A C H U S E T T S

The disease on white pine was first found in Massachusetts in a pine plantation in Andover, Essex County, June 24, 1909. Since then, and up to Jan. 1, 1930, the disease has been reported on pine in 285 townships. The degree of infection varies, but areas of what may be called local general infection have been noted especially in Essex County, both northern and southern Worcester County, northern Plymouth County, western Hampden County, western Franklin County, and southern Berkshire County.

Local spot infection can be found throughout the State and it is safe to say that upon diligent search, diseased pines can be found in any town where white pine is abundant.

F A C T S A B O U T T H E P L A N F O R C O N T R O L -
M A S S A C H U S E T T S B L I S T E R - R U S T P O L I C Y

The present plan for preventing the further spread of blister rust in this State, takes the form of a service campaign of education, demonstration, and instruction, organized for the purpose of accomplishing general control of the disease by furnishing to all interested parties, through personal contact, the essential facts relative to this disease and the simple methods by which its further spread can be checked. In accordance with this plan, the U. S. Department of Agriculture, thru its Office of Blister Rust Control, has assigned special agents to the more important pine-producing sections of the State to carry on this educational and service work.

The State, in carrying out its obligation, thru the State Department of Agriculture, guarantees under the plan, to aid pine owners by providing field men to supervise the actual practice of control work, that is to say, to assist pine owners in locating and destroy-

ing currant and gooseberry bushes which may be menacing valuable white-pine stands. The procedure has been to select a group of towns in each district each year, and to concentrate in these towns, so that the work might be handled systematically. In rendering service to the pine owner the State and Federal authorities are using the facilities which are at their disposal in an effort to fulfill an obligation to the community as a whole, while the responsibility for, and the actual cost of control work is borne by the individual owners whose interests are primarily at stake.

On April 1, 1927 an official order was issued by the Massachusetts Department of Agriculture outlawing the European black currant because of its unusual susceptibility to the blister rust. The plan is to completely eliminate such plants from the entire State although to date, such work has been practically restricted to those towns in which the general control program has been in progress.

The present plan of attempted control of blister rust in Massachusetts, was inaugurated in 1922. From that year and to Jan. 1, 1930 examinations have been made on more than 1,500,000 acres of white-pine producing lands including areas adjacent thereto. On this area of land more than 9 million wild Ribes were found and destroyed at an average cost of 13¢ per acre. During the same interval, it has been necessary to destroy over 200,000 cultivated Ribes because of their location within infecting distance of more valuable white pines. In this work involving the initial eradication of Ribes, cooperating land owners have expended the equivalent of \$63,000 in their own time or for the hire of laborers.

S T A T U S O F C O N T R O L T O D A T E

To the end of the 1929 field season, except for a few odd jobs, the initial eradication of Ribes from the pine sections of the State has been practically completed in Bristol, Essex, Franklin, Hampden, Norfolk, and Plymouth counties. In the other counties, with the possible exception of Worcester county; it is confidently expected that all the initial Ribes eradication work will be completed by the close of the 1930 field season.



FUTURE REQUIREMENTS
TO ACCOMPLISH PERMANENT CONTROL

When the initial eradication of Ribes has been completed, there will remain the task of completing the state-wide eradication of the European black currant and any reeradication of Ribes which may be deemed necessary.

From experience to date, it is apparent that one examination of any pine area will not succeed in accomplishing the complete eradication of Ribes and in establishing permanent control of the disease. Sprouts may develop from Ribes that were poorly uprooted; there will be an occasional bush missed in the first examination; there may be seedlings too small to be seen; and finally, it has been recently demonstrated that Ribes seeds remain dormant in the ground, and when conditions are favorable these seeds germinate and in time may partially restock the control area. Fortunately, not all of these conditions will prevail on any one area, but nevertheless they indicate the necessity for periodic examinations to keep an area effectively Ribes-free. The time period involved between eradication will vary of course, but it seems reasonable to say that a reexamination should

be made at least five years after the initial examination. In many instances, reeradication work will simply involve a reexamination or scouting of the area to determine conditions, while in other cases a new population of Ribes may be found which will require additional work to eliminate.

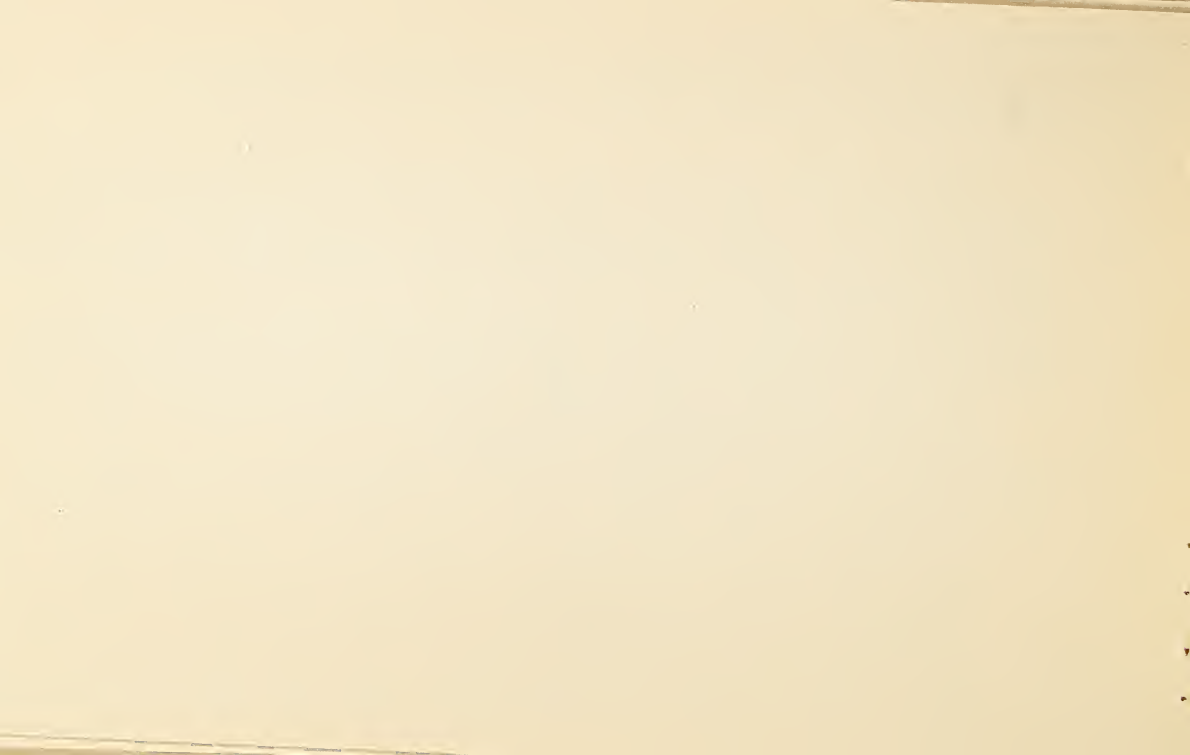
In many towns, Ribes were originally so few in number that it is quite possible that no further work will be requirsd. In other towns, white pine was found in too limited an amount to justify further efforts to eradicate Ribes. In other words, the plan will be to restrict reeradication work to those towns in which our experience and records show that there is a substantial growth of white pine and where Ribes were initially found in considerable abundance.

F A C T S A B O U T T H E M A S S A C H U S E T T S
B L I S T E R R U S T L A W A N D R E G U L A T I O N S

Blister-rust control work in Massachusetts is carried on by the Division of Plant Pest Control of the Massachusetts Department of Agriculture, under the authority of the provisions of Section 16 and 22, Chapter 128 of the General Laws as amended. These sections provide as follows:

Section 16: The Director of the Division of Plant Pest Control, and his assistants, may at all times enter any public or private grounds in the performance of any duty required by Sections seventeen to thirty-one, inclusive.

Section 22: If the Director, either personally or through his assistants, finds Ribes, that is, any variety of currants or gooseberries whether wild or cultivated, or five-leafed pines which are either infected with white pine blister rust, or so situated that in his opinion they are likely to become so infected, he or his assistants may destroy or cause to be destroyed such Ribes or five-leafed pines. In carrying out his duties under this section the Director shall as far as practicable



cooperate with the State Forester, local tree wardens, moth superintendents, city foresters and forest wardens.

Under Section 25 an owner has the right to object to the removal of the bushes in writing within ten days to the Commissioner of Agriculture and such an appeal acts as a stay of proceedings until the appeal has been heard and decided.

If the decision to remove the bushes is sustained, the owner must then remove them or they will be removed by the Director or his assistants and the cost of such removal assessed upon the owner.

Under Section 23 of the same chapter provision is made for the compensation of the owner for the loss of cultivated Ribes destroyed under Section 22, provided written claim is filed with the Massachusetts Department of Agriculture within 30 days of the time the bushes are destroyed.

Under Section 27 the Department has issued an official order prohibiting the planting of Ribes in approximately 200 townships in the State. These are towns in which white pine is an important community asset.

Under Section 27 there has also been issued the official order providing "that it shall be unlawful for any person to possess, propagate, sell or offer for sale" any plants of *Ribes nigrum* in the State of Massachusetts.

Federal Quarantine: Plant Quarantine No. 63 of the U. S. Dept. of Agriculture effective October 1, 1926 made inoperative the State quarantine established in 1918. One of the provisions of the federal act, however, provides that no five-leaved pines or *Ribes* can be shipped into Massachusetts unless accompanied by a permit from the Director, Division of Plant Pest Control, Mass. Dept. of Agriculture. Under this provision, permits are granted for the unrestricted entry of white pines but permits for *Ribes* are only granted for the shipment of such stock to towns not on the local control area list.



F A C T S A B O U T T H E
D U T I E S A N D R E S P O N S I B I L I T I E S
O F B L I S T E R R U S T F I E L D M E N

HIS DUTIES: The blister rust field man is to carry out any and all instructions given to him by the blister rust control agent to whom he is responsible. His job or duty is to assist with, supervise or inspect all Ribes eradication work performed by private cooperators at the direction of the blister rust control agent.

DAILY REPORT OF FIELD WORK- Every blister rust employee is required to make out a daily (Sundays excluded) report of the work on Form BR-1 and in duplicate. This form must be made out completely and then submitted to the blister rust control agent at such times and manner as he shall direct. In case of absence from work on any day, make out the report as usual and state the circumstances.

AUTOMOBILE REPORT CARDS: Employees operating automobiles for which they receive reimbursement from the State, must fill out a weekly report card showing speedometer mileage readings, total mileage each day, amount claimed, and statement of towns where auto was used. These cards provide for a daily entry; they must be made out completely, neatly and correctly and submitted to the agent at the close of work each Saturday.

EXPENSE ACCOUNTS: Employees who have expense accounts must fill out a weekly form in triplicate. Keep the third copy for your own information and submit the other two to the blister rust agent promptly every Saturday at the close of the day's work or as he may otherwise direct. When the 15th of the month does not come

on a Saturday, the form should be submitted at the close of work on that date and begin a new form on the 16th. The items on these forms must agree, of course, with those reported on the auto cards and on the BR-1 form for each day.

From the copy of the weekly account, a monthly account must be made out in duplicate and in ink on a form provided for the purpose and submitted to the blister rust control agent at the close of work on the 15th of each month. The period covered on these accounts is from the 16th day of the month to and including the 15th of the next month. Employees using automobiles must write the name or make of the auto used, in the lower left hand corner of the account form.

In addition to these forms, employees will be expected to furnish any other information that the blister rust control agent may from time to time request.

WILD RIBES ERADICATION: When a pine owner or an inexperienced laborer in working with you, particularly along stone-walls, it will be necessary for you to continually check up his work to see that he is not missing bushes, and to be certain that he is getting out the roots. In checking up on the other fellows' work, be sure that your own work is not at fault. When you make an appointment with an owner - BE THERE! Impress upon each owner that he should look upon currants and gooseberries as pests and that he should endeavor to eradicate them from his lands in the same way that he keeps weeds out of his garden. Tell him also, that the spring, usually from the last week in April to about the 10th of May, is the best time to check over his land; for the reason that Ribes are about the first plants to put forth their leaves and therefore, they can be more easily seen at that season.

Scouting: The results obtained from scouting are only as effective and efficient as the man who is doing the work. BE THOROUGH! Do not throw out an area as Ribes-free until you have "sampled" it well. Scouts are held responsible for all areas which they designate as Ribes-free. Be on the safe side and be certain of your ground before reporting on such areas.

White paint should be used to indicate the location of concentrations of wild Ribes using the circle with cross symbol painted on a conspicuous stone along the roadside. The location of infected pines should be indicated in a similar way but using the white-painted triangle. In both instances use directional arrows. While it is desirable to have these marks placed where they can be readily seen, do not place them at such frequent intervals and do not make them so large that they will be unsightly.

Mapping:

You will be furnished with field maps and will be given the necessary instructions by the agent, as to their use and development. It is essential that these maps be kept up to date to be of any value. This means that data should be recorded daily and while in the field, as the work progresses.

Crew Work: The following suggestions are made for the purpose of aiding you in improving the character of crew work. Give them your careful consideration.

1. Get your crew into the field at the appointed hour for starting work. If the foreman or men are seen loitering about town in the morning, it creates an unfavorable impression.
2. You should endeavor to keep your men in proper alignment in the crew as nothing appears quite so shiftless as to have the men straggling along.
3. Be sure that a satisfactory paper trail is left so that no ground between strips will be overlooked. Marking the line with broken branches is not efficient.



4. When one or more men are busy pulling Ribes, have the other men scout back rather than stand about waiting. Let the slogan be "Keep Moving."
5. In directing the crew, it is not essential or even desirable to appear officious or too bossy, but the use of such expressions as "What do you say, boys," "We're off," "Let's go," etc. will help to keep everyone on the move.
6. Checking is very important! Have the crew check back on the work just as frequently as is consistent with efficiency. When you are in areas where patches of Ribes are quite abundant, check "early and often."
7. In uprooting Ribes, be certain that the men get all the roots. There is absolutely no excuse for leaving the roots after you have found a bush. Nothing will react against our work more than sprouting from broken roots left in the ground. GET THE ROOTS!

REMOVAL OF CULTIVATED RIBES: It is most important for all field men to know that the authority for the removal of cultivated Ribes is vested entirely in the STATE DEPARTMENT of Agriculture by STATE LAWS. NEVER SAY that the federal government has any such authority. The federal department has no such authority. Remember this!

Before removing cultivated Ribes, field men should secure specific instructions from the blister rust control agent in charge. In addition to such specific directions, the following general instructions should always be followed carefully:

1. Inform the owner concerning the disease, control work and the necessity for the removal of the bushes.
2. If the owner objects to removal or brings up the question of compensation, try to impress upon him his duty to help control the disease in his local community and ask him to donate his bushes to the cause of the protection of the white pine in his



town. Call his attention to the fact that during the past eight years (1922-29) only 3 owners in every 100 have refused to remove their bushes without reimbursement. If this fails, and the owner absolutely refuses to have the bushes removed, refer the case to the blister rust control agent in charge, for his action and disposal.

3. Examine, classify and record all cultivated Ribes when you first find them. If they are not to be removed immediately make the record on a blue Cultivated Ribes Removal Card.
4. Upon the removal of any cultivated Ribes, fill out a white Cultivated Ribes Removal Card. Be sure to enter on the card the town and block number in addition to the address of the owner. In classifying the bushes use the following scale.

Class 1: Fruiting plants 4 years or older

(a) In good state of cultivation

(b) In sod and uncultivated but not entirely neglected

- Class 2: Fruiting plants 2 to 4 yrs. old
(a) In good state of cultivation
(b) In sod and uncultivated but not entirely neglected
- Class 3: Fruiting plants, run down, depreciated by age or lack of recent care.
- Class 4: Plants in sod and dying of neglect
- Class 5: Young plants, not fruiting (determine date planted)
- Class 6: Plants entirely neglected, worthless

HIS RESPONSIBILITIES: Blister rust field men are responsible directly to the blister rust control agent. All field men, however, are expected to cooperate at all times and to the best of their ability with any State or Federal blister rust officers who may visit them. These men do not come to find fault, but rather to assist in improving our work. A friendly spirit of cooperation between all concerned will be of great benefit to the work.

As public servants, remember that your work involves the expenditure of public money raised by taxation, and be sure to return full measure for value received. You should remember that your work is subject to the critical eye of the public. See to it that your conduct and that of the men associated with you is such that criticism will not be adverse. Whenever you are working alone, be sure to keep on the move. Remember also that your conduct after working hours is just as important as that during the day. If anyone seeks information from you regarding blister rust and its control, answer the questions if you can and if you can not or if more detailed information is needed, refer the inquiry to the blister rust control agent. The public is entitled to know what we are doing, how we are attempting to do it, and why!

PREVENT FOREST FIRES! At all times care must be exercised to prevent forest fires! Smoking on the job has a most unfavorable impression on the general public - the tax payers - and is really dangerous from the standpoint of forest fires. For that reason especially -

SMOKING IN THE WOODS CANNOT BE TOLERATED

You will of course, do everything possible to put out any fire that you discover, and immediately notify the local fire warden if additional assistance is needed.

The following advice originally given to the blister rust workers in New Hampshire, by State Blister-Rust Leader Newman of that State, is applicable to the workers in Massachusetts.

SEE THAT YOU AND YOUR CREW ARE EVERLASTINGLY ON THE JOB!

THE PUBLIC WILL BE WATCHING

SHOW THEM

THAT BLISTER-RUST MEN MEAN BUSINESS

The cooperation of all blister-rust workers is earnestly solicited so that we may continue to have the support and endorsement of the public in the service which we are endeavoring to render.

F A C T S A B O U T O T H E R P E S T S O F W H I T E P I N N E

Relatively speaking, white pine is not susceptible to many plant pests, but there are a few which do attack the species to some extent and the injury which they inflict is often mistaken for blister rust. In order to assist you in making intelligent reply regarding these few rather common pests, the following brief descriptions are included at this point. These pests include a few insects; namely, the white-pine weevil, Pales weevil, the pine bark apid, mound-building ants. One fungus commonly known as Phoma is also of importance. Finally, the so-called needle blight, which apparently cannot be traced either to insects or fungus disease, is mentioned briefly.

THE WHITE PINE WEEVIL

Brief description: The unfailing sign of the presence of white-pine weevil is the wilting and dying back of the terminal or leading shoots of white pines. It is particularly noticeable

on trees of relatively small size, 2 to 15 feet in height. This injury is the result of a process of girdling, due to the activity of a small beetle which lays its eggs in the terminal shoot. These eggs hatch into small white grubs which immediately begin feeding just beneath the bark on the wood of the shoot. As the grubs increase in size, they feed deeper into the wood, working downwards. The leader is soon girdled and immediately begins to wither and turn brown. The result of this destruction of the main shoot is that the tree becomes crooked, since, after the destruction of the terminal shoot, one of the branches grows upwards to make a new trunk. Repeated attacks result in a decidedly stunted and forked tree.

Life history and description: The winter is passed by the adult insects - reddish brown to very dark brown beetles about one-quarter of an inch long, with a rather stout, long, snout - within the shelter of the leaves or refuse under the trees. The beetles resume activity from March to the middle of May and feed upon the bark, sap and buds of the leading shoot.

They cut small holes in the shoot and deposit their eggs therein. After a few days, the eggs hatch and the resulting larvae - white, footless, grub-like, about one-quarter of an inch long when full grown - begin feeding inward and downward, girdling the tissues of the shoot as they progress. By August, the larvae construct nest like fibrous cells in the wood and transform into pupae - creamy white with brown head and about the size of the adult. After resting a short time the pupae transform to the adult or beetle stage. A neat round hole is then eaten thru the confining wall of the host, and the beetle emerges.

Method of control: No practical control measures, in the case of an extensive area of white pine, have been developed, except through proper spacing and species-mixtures. In the case of a few trees, the most effective method has been the cutting off and burning of the attacked leaders or terminal

shoots before the adults emerge in August. The close planting of the young trees used in establishing a plantation, is effective in partially preventing the deformation of the young trees. Where pines are growing in groups with older trees, there is apparently less damage by the weevil. Plantations and natural pine stock in the open, suffer the most from attack by this insect.

Confusion of the injury with blister rust! The average individual associates the weevil injury with blister rust simply because of the rusty color of the dying shoot. None of the other characteristics of blister rust are present in the case of weevil damage and blister rust injury is seldom confined so characteristically to the terminal shoot.

PALES WEEVIL

Brief description: Young seedling or sapling pines are often seriously injured by the attack of small snout beetles known as the Pales Weevil. These insects are ravenous feeders, eating the tender bark from young pines or the younger bark on larger sized pines. When the attack is sufficiently severe, large numbers of the smaller trees may be completely girdled, while on the older trees, large numbers of the smaller branches all over the trees may be killed.

Life history and description: The adult beetles - dark, chestnut-colored weevils, $\frac{3}{8}$ of an inch in length - are responsible for the injury done. The beetles feed only during the night, so it is almost impossible to detect them on the plants which they are attacking. They hide near the trees during the day time, under bits of wood, stones, or other refuse.

Methods of control: There is no practical control of this insect, but serious damage can be avoided by not planting pine trees in cut-over areas for at least three years after the timber has been cut. Damage may be materially reduced by burning the slash over the freshly cut stumps, and utilizing the logs before spring. The point is that the insects are attracted by the odor of the freshly cut pine stumps, logs, boards, or even slash.

Confusion of the injury with blister rust damage: There should be no reason for confusing the injury caused by the activities of this insect, with that of blister rust. Examination will readily disclose the distinctly "chewed" condition of the bark, especially when the injury has been freshly inflicted.

PINE BARK APHID

Brief description: The pine bark aphid is a true plant louse, but is rarely seen, since usually it is hidden beneath a mass of white, cottony, secretion. These cottony masses occur in greatest abundance on the trunk and large branches of the host and when numerous are very conspicuous. The lice occur in large numbers and take an immense amount of vitality from the trees attacked. Pines attacked by this insect become sickly the leaves turn yellow, limbs may die and occasionally the entire tree succumbs. The white patches on the trunks or branches of the larger sized trees disfigure and seriously detract from their appearance.

Methods of control: In plantations, these aphids may be destroyed by spraying the trees early in the spring about the time new growth starts, with 40% nicotine sulphate - "Black leaf 40" - used at a dilution of one part nicotine to 800 parts of water (1-800) dissolving 1 ounce of soap in each gallon of

water. Kerosene emulsion and soap and water solution are also used effectively.

Confusion of the injury with blister rust damage: Of all the pests of white pine, the work of the pine bark aphid is most often confused with damage by blister rust. The only explanation is a psychological one, due to the fact that these colonies of aphids are so strikingly white, that persons simply think of the name white pine blister rust. There is perhaps one similarity in the nature of the damage, for when a pine is seriously attacked there usually develops a general browning of the foliage, producing a condition often referred to as the "yellows." Following a heavy infestation of these insects, there often develops on the bark of the trunk and branches, a very black sooty deposit. This growth results from the fact that the aphids secrete a sweetish liquid, known as "honeydew," which is an ideal medium for the development of the spores of the sooty fungus.

MOUND-BUILDING ANTS

Brief description: The so-called mound-building ants are of considerable importance because of their attacks on small pines under six feet in height and they often destroy all vegetation around their nests for a radius of twenty feet. The ants are supposed to kill the trees by injecting formic acid into the tissues of the main stem at a point just above the ground. The acid coagulates the cell contents, thus preventing the downward flow of sap.

Methods of control: These ant colonies are not easily destroyed, as the queens, or mothers, live deep down in the nest, often five or six feet below the surface of the ground, and unless these are killed, the colony will continue to live. The use of carbon bisulphide has, however, proved very satisfactory in destroying the colonies. A pint or so should be poured into the center of the mound if it is a good sized one. A few holes punched into the mound with a stick will assist in allowing the gases to penetrate. A few shovelfull of dirt

should be thrown over the mound to prevent the escape of the ants as they endeavor to get away from the gas.

Carbon bisulphide gas is heavier than air and penetrates deep into the nests. The liquid evaporates readily upon exposure.

CAUTION! Carbon bisulphide is very inflammable and should be used with care.

Confusion of the injury with blister rust damage: The injury caused is a shrinking of the tissues, causing a girdle. Associated with this constriction, is a yellowish discoloration of the adjacent uninjured bark. In other words, the damage is strikingly like that of blister rust, except that there is no swelling as in the case of a blister rust canker. However, when such injury is noted in the woods, careful search will always disclose the existence of one or more mounds nearby and a very pronounced area in which the trees are either dead or dying.

PHOMA

Brief description: Oftentimes pines will show "flags" that give every indication of the presence of blister rust, at least from a distance. Upon close examination, however, it is found that the injury is due to the attack of a fungus of the genus Phoma (pronounced Fo-mah). This fungus causes a shrinking or constriction of the tissues where the bark and cambium have been killed. In the dead bark there is usually present large numbers of small black pustules. There is, however, no yellowing of the healthy bark above and below the canker as in the case of blister rust. The needles of a branch attacked by Phoma are usually reddish in color rather than the characteristic straw color of the blister rust "flag". Phoma is often found in plantations, particularly where the planting

has been poorly done, or where the trees have unfavorable conditions to contend with.

Control: There is no control, but it is always advisable to recommend the destruction of a small infected specimen or of the diseased branches of a larger tree.

Confusion of the injury with blister rust damage: The constriction closely resembles that of the blister rust canker, but no discoloration of the healthy bark above and below the constriction is present. There is no marked swelling of the tissue as in the case of blister rust. The injury, however, is quite often confused with that of blister rust, especially in the case of young trees growing in pine plantations.

NEEDLE ELIGHT OF PINES

General description: The term "white-pine blight" has been rather loosely applied to a number of troubles. In general, however, the term is applicable to the condition which has prevailed in the past in several sections, where individual trees or groups of trees have suddendly turned brown or "rusted," and have been most conspicuous in the landscape. There is some difference of opinion as to the cause of the injury, but it is generally agreed that it is not caused by either insects or fungi. The best of opinion seems to be to the effect that the injury is due to one of two causes; namely, a winter injury causing the death of extensive portions of the sap wood, or an injury of some sort to the entire root system of the trees, either of which would result in a shortage of water for the use of the needles and cause them to dry up and turn brown as they do in the case of this blight.

Control: Since the trouble is apparently physiological there is no remedy.



Confusion of the injury with blister rust damage: This trouble when at all prevalent is very generally confused with blister rust probably because of the rusted appearance of the foliage of the trees affected. In the case of the needle blight, the entire tree becomes rusted and the condition of "flags" is entirely absent. The color of the foliage also has a characteristically reddish tinge. None of the usual symptoms of blister rust are present.

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WHAT ABOUT THE CHESTNUT? IS IT COMING BACK?

There is no more frequent inquiry met with in the field than the above query regarding the possible reestablishment or "come back" of the native American chestnut tree.

The chestnut blight was first found in the U. S. in 1904 in Bronx Park, New York City. It spread rapidly northeastward, westward, and southwestward. By 1926 nearly all the mature chestnut in southern New England, southeastern New York, New Jersey, eastern and central Pennsylvania and Maryland, and northern Virginia had been killed. Local infections had also been reported in sections of West Virginia, North Carolina, Virginia, Tenn., Georgia, and South Carolina. As a result of this phenomenal spread of the disease, it has been generally conceded that there is no practical method of stopping its spread.

In Massachusetts and in other sections in fact, sprouting has taken place from blight-killed chestnut trees. At the present time, some of the sprouts attain considerable size, frequently produce nuts, and in many cases do so in spite of the blight cankers in the stems. Just what the ultimate result of this struggle between host

and parasite will be, is problematical. In time an immunity may develop. It is reasonable to say, however, that the species as a producer of an economically important crop of timber, will not "come back" in this generation. It may, in the next.

The Office of Forest Pathology has introduced many strains of the forest type of Asiatic chestnuts which are very resistant to the blight under Asiatic conditions. Some forestry plantings with these introductions will be made in Massachusetts this spring, in cooperation with state authorities. Dr. Perley Spaulding, of the Office of Forest Pathology, Amherst, Mass., is interested in receiving reports of Asiatic chestnuts which have survived the blight and reports of unusually resistant American chestnut trees and sprouts. All Asiatic chestnuts are worth reporting, but it is only very exceptional American chestnuts that are worthy of noting.



The fact remains, however, that as a result of the chestnut blight, there has almost vanished from the forests of the country a most valuable timber tree species. The chestnut was particularly valuable to the farmer and small woodlot owner who was able to derive a relatively quick return because of its rapidity of growth and sprouting ability.

While the blister rust differs entirely from the chestnut blight, the almost complete disappearance of the chestnut can be cited as an example of what one fungous disease has wrought.



The material assembled in this mannual has been taken from the most reliable sources of available information. It seems unnecessary to cite the sources in a text of this type. In the preparation of the manual, free use without acknowledgment, has also been made of material released through the Office of Blister Rust Control, Bureau of Plant Industry, United States Department of Agriculture at Washington. The cooperation of Mr. Roy G. Pierce of that office has been invaluable in the preparation of the several editions of this aid to blister rust field men.

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C. C. Perry, January 1, 1930.
